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(54) **Fan with blades having integral rotating venturi**

(57) A low noise fan (1) reduces the production of turbulent vortices created by the passage of the fan's blade (3) tips through the air by providing an annular venturi (4) that is attached at its inner surface to the blade tips, and that thus rotates with those blades as a unit. This prevents high pressure air at the blade tips from spilling into low pressure air. The outer surface of the rotating venturi may have a close fit against the inner surface of an outer annular stationary housing (14) of the fan, to minimize any acoustic or mechanical mischief created by the otherwise exposed outer surface of the rotating venturi (4).

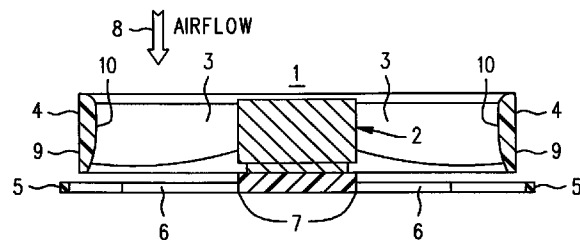


FIG. 2

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Description

Background Of The Invention

An item of electronic equipment that dissipates more power than can easily be cooled with heat sinks alone generally uses fans to supplement natural convection. This works well enough, but as anyone who has labored in a room full of fan cooled equipment can attest, the noise from the fans themselves can be rather annoying. This is especially so in an office setting, where there arise issues of decorum, in addition to the more pragmatic issues of productivity reduction owing to distractions caused by noise.

A significant amount of fan noise appears to originate with the production of turbulent vortices of air at the tips of the fan blades as they rotate about the fan's axis. The tips pass sideways, as it were, through low pressure air located between the stationary venturi and the moving blade tips. As the blades rotate high pressure air spills over the tips of the blades and imparts an off axis spinning motion in the low pressure air (vortices) whose turbulent behavior results in the production of acoustic energy (noise).

It would be desirable if fan noise could be reduced without sacrificing the air flow the fan is intended to supply.

Summary Of The Invention

A solution to the problem of fan noise is to reduce the production of turbulent vortices created by the passage of the fan's blade tips through the air. This may be done by providing an annular venturi that is attached at its inner surface to the blade tips, and that thus rotates with those blades as a unit. This prevents the spilling over the blade tips of high pressure air into low pressure air. The outer surface of the rotating venturi may have a close fit against the inner surface of an outer annular stationary housing of the fan, to minimize any acoustic or mechanical mischief created by the otherwise exposed outer surface of the rotating venturi.

Brief Description Of The Drawings

Figure 1 is a simplified top view of a fan having a rotating venturi attached to the blades of the fan; Figure 2 is a simplified cross sectional view of the fan of Figure 1; Figure 3 is a simplified top view of a fan similar to the one in Figure 1, but having an additional annular housing surrounding the rotating venturi; and Figure 4 is a simplified cross sectional view of the fan of Figure 2.

Description Of A Preferred Embodiment

Refer now to Figures 1 and 2, wherein are shown a

top view and a cross sectional side view of a fan 1 constructed in accordance with the invention. In particular, a hub 2 is rotatably mounted on a base 5 that includes an open interior region spanned by struts 6. The struts 6 support a central location 7 within the base 5, onto which the hub 2 is mounted. A plurality of blades 3 are attached to the hub 2. A small motor (not shown) under the hub 2 causes the hub and the blades 3 attached thereto to rotate. The direction of airflow is shown by the heavy arrow 8.

An annular venturi 4 is attached to the distal ends of the blades 3, and rotates about the hub as do the blades 3. The annular venturi 4 has an outer surface 9 that may, if desired, be parallel to the axis about which the hub 2 rotates, and has an inner surface 10 that, in a known manner, may resemble an airfoil.

Finally, note that the open interior region (not itself readily depicted) has an outer edge 11. This edge 11 is visible because the diameter of the interior region it represents is slightly larger than the outer diameter of the rotating annular venturi 4. The relative sizes of these diameters is a matter of choice, and it may be desirable for the diameter associated with edge 11 to be greater than the inside diameter of the rotating annular venturi 4 and less than its outer diameter.

Now consider the embodiment for fan 12 of Figures 3 and 4, where similar or unchanged elements have the same reference characters. Note in Figures 3 and 4 the stationary housing, or collar, 14. It is essentially a section of a cylinder that is either simply a molded part of, or is attached to, the base 13. There are many possible reasons for wanting such a housing or collar 14, and they include protecting the rotating annular venturi 4 from inadvertent contact with other objects, acting as a stiffener for the base 13 and serving as a location for mounting a screen.

As before, the exact diameter of the interior region represented by edge 11 is a matter of choice.

The rotating annular venturi 4 of both embodiments described above reduces fan noise by eliminating the vortices created by the passage of the tips of the blades 3 through low pressure air, and by the subsequent spilling of higher pressure air outward in a radial direction into that low pressure air. In the embodiment of Figures 3 and 4 it may be desirable to minimize the gap between the outer surface of the rotating annular venturi 4 and the inner surface of the stationary housing or collar 14 to a practical minimum, say, a few hundredths of an inch. A compromise may be necessary between turbulence and drag.

Claims

1. A fan (1) comprising:

a frame (5),

a hub (2) rotatably mounted to the frame for

rotation about an axis;

a plurality of pitched blades (3) attached at inner ends thereof to the hub and that in a direction toward outer ends thereof project away from the hub; and

an annular venturi (4) centered about the hub, having an inner surface (10) that generally faces the hub and that is attached at that inner surface to the outer ends of the plurality of blades, the annular venturi rotating about the axis of the hub as the hub rotates.

2. A fan as in claim 1 wherein inner surface (10) has a generally circular intersection with a plane normal to the axis of the hub, and the diameter of that intersection at a location near where air enters the annular venturi is less than at a location near where air exits the annular venturi.

3. A fan as in claim 1 wherein the frame (5) further comprises an open interior region allowing the passage of air therethrough, the interior region is bounded by a periphery from which struts (6) converge toward and meet at a central location (7) within the open interior region, and the hub is rotatably mounted at the central location.

4. A fan as in claim 3 wherein the periphery is generally square and has mounting holes near its corners for attaching the fan to a surface.

5. A fan as in claim 3 wherein the frame further comprises a stationary housing (14) disposed about the annular venturi (4) and enclosing an outer surface thereof.

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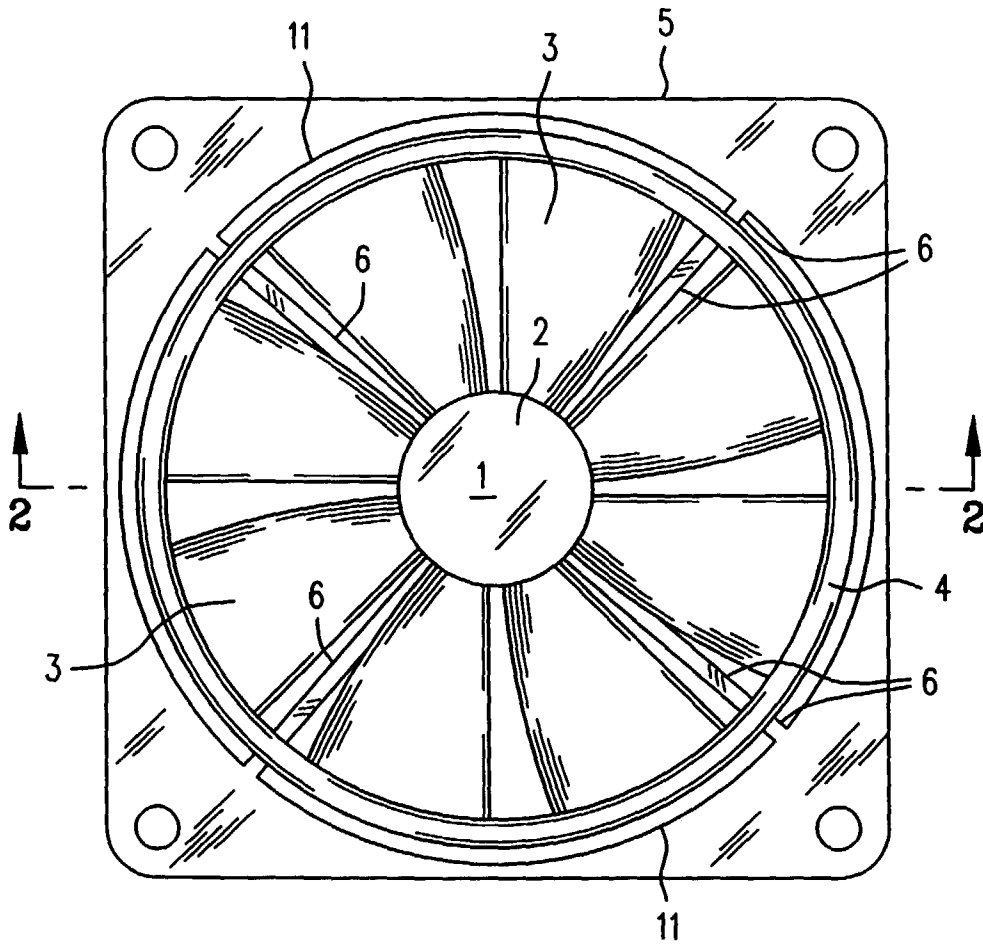


FIG. 1

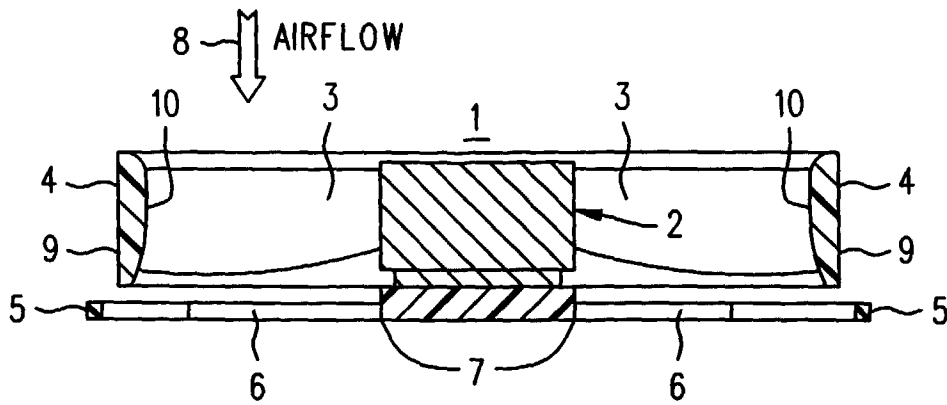


FIG. 2

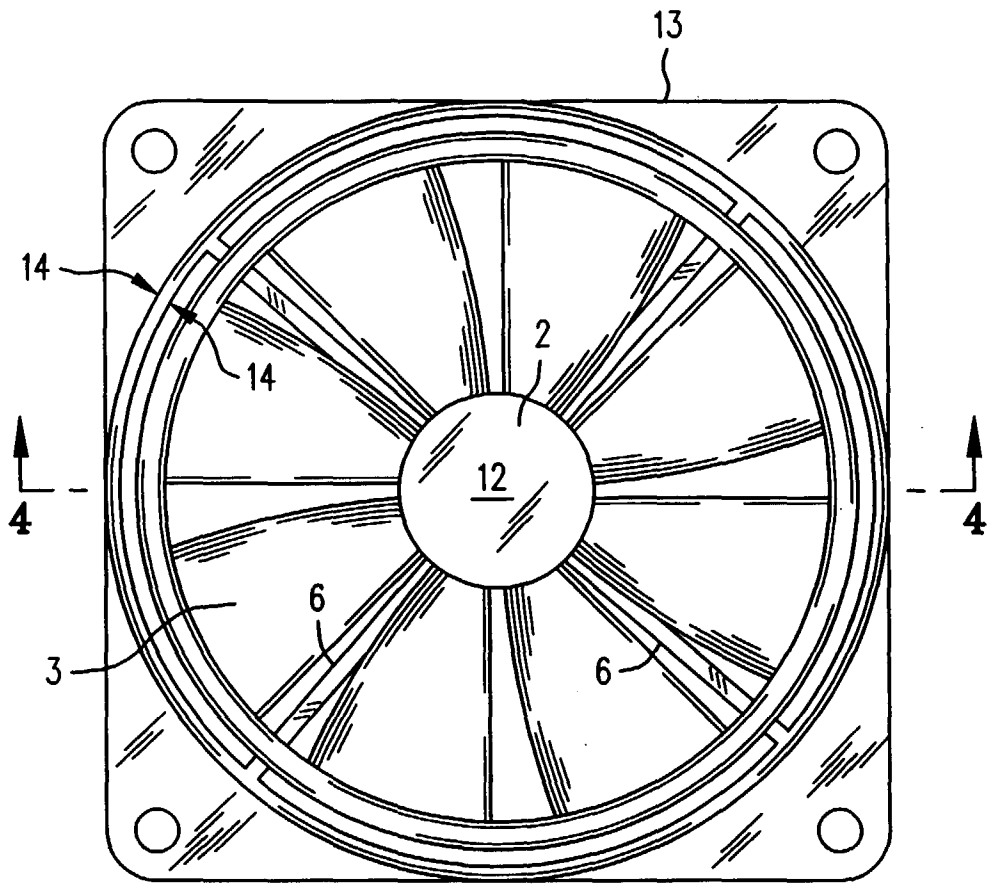


FIG. 3

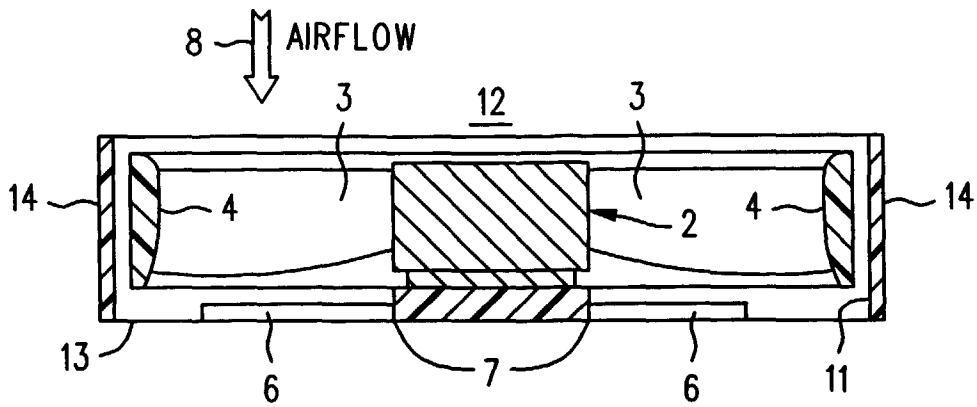


FIG. 4